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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/736,812	12/14/2000	Steven L. Smith	81940DMW	8696

7590 10/24/2003

Thomas H. Close
Patent Legal Staff
Eastman Kodak Company
343 State Street
Rochester, NY 14650-2201

EXAMINER	
TUCKER, WESLEY J	

ART UNIT	PAPER NUMBER
2623	

DATE MAILED: 10/24/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 09/736,812	Applicant(s) SMITH ET AL.	
	Examiner Wes Tucker	Art Unit 2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-6 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-6 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 3-26-01 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 5 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,729,631 to Wober in view of U.S. Patent 5,881,182 to Fiete.

With regard to claim 1, Wober discloses a method of removing noise from multi-band digital images in an original spectral space, said method comprising the steps of

a) selecting a plurality of bands of a multi-band image to perform noise removal operation upon (column 2, lines 32-35). Wober discloses removing noise from an image by performing noise modeling at "various frequency levels." Modeling noise at various frequency levels is equivalent to selecting a plurality of bands.

b) transforming each of the bands of the multi-band image to a spectral space advantageous for noise removal for multi-band imagery (column 2, lines 37-41). Wober discloses representing the signal as a pyramid consisting of different levels corresponding to different frequency bands. Representing the signal according to different frequencies is equivalent to transforming bands to an advantageous spectral space for streak removal.

c) performing a noise removal operation on each band in the advantageous spectral space using information from the other spectral bands (column 13, lines 46-49). Here Wober discloses noise modeling and subsequent filtering. The noise is also filtered at all frequencies or each band. The filtering for each band depends on the other spectral bands or range of frequencies because of the way the DCT coefficients are determined. Each coefficient corresponds to a certain frequency range and is calculated using other coefficients for other frequency bands. This method is referred to as “down-sampling” (refer to column 11, lines 12-41). Wober does not disclose removing streaks, which are a form of noise.

d) transforming the noise removed bands from the advantageous spectral space back to the original display space (see abstract). Here Wober discloses “the image is restored with reduced noise.” So after the noise is reduced, the image is restored in the original spectral space.

Wober does not disclose applying the noise removal to removing streaks. However streaks are a well known from of noise. For example Fiete discloses removing streaks, as a type of noise, from images. Fiete states that “streaks not only reduce the aesthetic quality of digital images but can impact the interpretability of features in the images. Streaking also severely degrades the performance of pattern recognition and feature extraction software” (column 1, lines 60-64). Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to apply Wober’s method, to remove unwanted streaks as taught by Fiete in order to increase the aesthetic quality of the image

as well as provide better interpretability of the image for use with pattern recognition and feature extraction software.

With regard to claim 2, Wober discloses a method wherein the spectral space advantageous for noise removal for multi-band imagery is dependent on at least one of the number of the bands of data, and the spectral band pass of each of the imaging bands (column2, lines 37-41). Here Wober describes the advantageous spectral space as a pyramid representation of the image signal in which each level of the pyramid corresponds to a different frequency level or band of image signal data. Wober further discloses a method wherein the spectral space advantageous for noise removal for multi-band imagery is dependent on imaging band dependent characteristics of the one or more sensors used to capture the bands (column 3, lines 48-52). Here the sensors used to capture bands are included in the hardware of a noise removal system which includes a discrete cosine transform processor and a Wiener filter combined for removing all frequencies of noise from an image. The discrete cosine transform processor is used to capture the bands and is dependent on frequencies of image signal. In the Wober-Fiete combination, the technique would be applied to streak removal as discussed with respect to claim 1.

With regard to claim 3, Wober discloses the transformation performed in step b) consists of a linear combination of the original bands (column 2, lines 37-44). Wober discloses a pyramid representation of the signal where different levels of the pyramid correspond to different frequency bands. The signal is transformed with discrete cosine

transform coefficients for each frequency band. This is a linear combination of the original bands. In the Wober-Fiete combination, the technique of linear combination of bands would be applied to the method for streak removal as discussed with respect to claim 1.

Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,881,182 to Fiete in view of Patent 5,729,631 to Wober.

With regard to claim 4, Fiete discloses a method of removing columnar streaks from a multi-band digital image of the type in which it is assumed that pixels in a predetermined spatial and spectral region near a given pixel are strongly related to each other and employing gain and offset values to compute streak removal information comprising: testing for a strong relation between the pixels in a predetermined spatial and spectral region near a given pixel and computing streak removal information only if such a strong relationship exists, whereby image content that does not extend the full length of the image in the column direction will not be interpreted as a streak (See Abstract).

Fiete does not disclose the improvement comprising: transforming the pixels of the multi-band image to a spectral space advantageous for streak removal, wherein the transformation is a linear combination of at least two of the original bands. Wober discloses this improvement (column 2, lines 37-44). Wober discloses a pyramid representation of the signal where different levels of the pyramid correspond to different frequency bands. The signal is transformed with discrete cosine transform coefficients for each frequency band. This is a linear combination of the original bands.

Wober discloses an image noise reduction system that applies "noise masks" at different levels of a pyramid image representation. Wober discloses reducing noise in an original spectral space. Each level of the pyramid described by Wober corresponds to a transformation of the signal using a different frequency band (column 2, lines 34-42). The signal represented at different frequency bands allows for the noise removal in an original spectral space.

Wober teaches "Signal dependent noise which is much more difficult to reduce than additive noise, can be reduced by first transforming the noisy signal into a domain where the noise becomes signal independent, then removing the signal independent noise using a conventional method such as Wiener filtering." Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to perform the streak removal method of the patent after transforming bands of a multi-band signal to a spectral space advantageous for streak removal or noise removal, because the noise or streaks could be made signal independent in the frequency domain and thus easier to remove.

With regard to claim 5, Fiete discloses a method of removing streaks in a digital image, said method comprising steps b) through h).

b) detecting pixel locations in the image where pixel-to-pixel differences caused by streaking can be distinguished from normal variations in the scene data (column 2, lines 48-51);

c) performing a linear regression to determine an initial estimate of the gain and offset values between each pair of adjacent pixels in a direction perpendicular to the streaking using the pixel values at the detected locations (column 2, lines 51-53);

d) performing a statistical outlier analysis to remove the pixel values that are not from streaking (column 2, lines 53-54);

e) performing a linear regression to determine the gain and offset values between each pair of adjacent pixels in a direction perpendicular to the streaking using the pixel values at the detected locations that are not statistical outliers (column 2, lines 55-60);

f) setting the slope value to unity if it is not statistically different from unity (column 3, lines 55-60);

g) setting the offset value to zero if it is not statistically different from zero (column 2, lines 55-60);

h) using the slope and offset values to remove streaking from the corresponding line of image data (column 2, lines 55-60);

Fiete doses not disclose steps a) and i).

Wober discloses step a) transforming a multi-band image to a spectral space advantageous for noise removal for multi-band imagery, thereby forming a transformed image (column 2, lines 34-42). Wober discloses reducing noise in an original spectral space. Each level of the pyramid described by Wober corresponds to a transformation of the signal using a different frequency band. The signal represented at different frequency bands allows for the noise removal in an original spectral space.

Wober also discloses step i) transforming the streak removed transformed image from the advantageous spectral space back to the original display space (see abstract). Here Wober discloses "the image is restored with reduced noise."

Wober teaches "Signal dependent noise which is much more difficult to reduce than additive noise, can be reduced by first transforming the noisy signal into a domain where the noise becomes signal independent, then removing the signal independent noise using a conventional method such as Wiener filtering." Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to perform the streak removal method of the Fiete after transforming bands of a multi-band signal to a spectral space advantageous for streak removal or noise removal, because the noise or streaks could be made signal independent in the frequency domain and thus easier to remove. Then of course the noised reduced image could be transferred back to the original display space.

With regard to claim 6, Fiete discloses a method for removing columnar streaks in a digital image, comprising steps b) through e) and g) through r), but not steps a), f), and s).

b) selecting first and second adjacent columns of pixels from the transformed digital image (Fig.4A, element 30);

c) forming a column of pixel value pairs, representing the pixel values of the adjacent pixels in the two columns (Fig.4A, element 32);

d) forming columns of local mean values, representing the mean values of pixels in an N-pixel window for each column (Fig.4A, element 34);

e) forming columns of mean-reduced values, representing the pixel value minus the corresponding local mean values in each column (Fig.4A, elements 36 and 38);

g) forming a column of difference metric values, representing the sum of the squares of the difference between corresponding mean reduced values in an N pixel window (Fig.4A, element 38);

h) forming a first reduced column of pixel value pairs by removing from the column of pixel value pairs, those pixel values whose absolute difference between the pairs is greater than a predetermined difference threshold (Fig.4A, element 38);

i) forming a second reduced column of pixel value pairs by removing from the first reduced column of pixel value pairs, those pixel values whose corresponding difference metric values are greater than a predetermined difference metric threshold (Fig.4A, element 38);

j) forming first slope, offset, and standard error values by performing a linear regression between the pair of pixel values in the second reduced column of pixel value pairs (Fig.4A, element 40);

k) forming a column of linear prediction values using the slope and offset values and the first pixel value of the pair of pixel values in the second reduced column of pixel value pairs (Fig.4A, element 42);

l) forming a column of regression error values, representing the difference between the second pixel value of the pair of pixel values in the second reduced column of pixel value pairs (Fig. 4B, element 44);

m) forming a third reduced column of pixel value pairs by removing from the first reduced column of pixel value pairs, those pixel values whose corresponding regression error values are greater than a predetermined regression error threshold related to the standard error value (Fig. 4B, element 48);

n) forming second slope and offset values by performing a linear regression between the pair of pixel values in the third reduced column of pixel value pairs (Fig. 4B, element 50);

o) setting the second slope value equal to unity if it is determined to not be statistically different from unity (Fig. 4B, element 52);

p) setting the second offset value equal to zero if it is determined to not be statistically different from zero (Fig. 4B, element 56);

q) adjusting the value of each pixel in the second column of pixels in the digital image by multiplying each value by the second slope value and then subtracting the second offset value (Fig. 4B, element 58);

r) repeating steps a-o for all adjacent columns of pixel values in the image (column 2, lines 37-40);

Fiete does not disclose steps a), f), and s)

Wober discloses steps a), f), and s).

Wober discloses step a) transforming the multi-band image to a spectral space advantageous for noise removal for multi-band imagery, thereby forming a transformed image (column 2, lines 37-41). See discussion for claim 5a.

Wober also discloses step f calculating the correlation between bands in the local region. The filtering for each band depends on the other spectral bands or range of frequencies because of the way the DCT (discrete cosine transform) coefficients are determined. Each coefficient corresponds to a certain frequency range and is calculated using other coefficients for other frequency bands. Therefore a correlation is calculated between bands by using the DCT coefficients. This method is referred to as "down-sampling" (refer to column 11, lines 12-41). Wober uses the method of "downsampling" to calculate noise variation according to the different bands. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to calculate the correlation between bands in the local region in order to calculate the noise associated with different bands.

Wober also discloses step s) transforming the streak removed transformed image from the advantageous spectral space back to the original display space (see abstract). See discussion for claim 5i.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969).
A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 4-6 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-3 of U.S. Patent No. 5,881,182 in view of U.S. Patent No. 5,729,631 to Wober. Although the conflicting claims are not identical, they are not patentably distinct from each other because the differences between the claims of the instant application and those of the patent are only minor.

With regard to claim 4, patent claim 1 recites a method of removing columnar streaks from a multi-band digital image of the type in which it is assumed that pixels in a predetermined spatial and spectral region near a given pixel are strongly related to each other and employing gain and offset values to compute streak removal information comprising: testing for a strong relation between the pixels in a predetermined spatial and spectral region near a given pixel and computing streak removal information only if such a strong relationship exists, whereby image content that does not extend the full length of the image in the column direction will not be interpreted as a streak (See Abstract).

The patent does not disclose the improvement comprising: transforming the pixels of the multi-band image to a spectral space advantageous for streak removal, wherein the transformation is a linear combination of at least two of the original bands. Wober discloses this improvement (column 2, lines 37-44). Refer to discussion of claim 4 in the 103 rejection above.

With regard to claim 5, claim 2 of the patent recites the steps b) through h), but does not recite steps a) and i). Wober discloses the steps a) and i). Refer to discussion of claim 5 in the 103 rejection above.

With regard to claim 6, claim 3 of the patent recites the steps b) through e) and g) through r), but not steps a), f), and s). Wober discloses steps a), f), and s). Refer to discussion of claim 6 in the 103 rejection above.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wes Tucker whose telephone number is (703) 305-6700. The examiner can normally be reached on 9AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703) 308-6604. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

wjt

Jon Chang

Jon Chang
Primary Examiner